Physical and Engineering Sciences Center

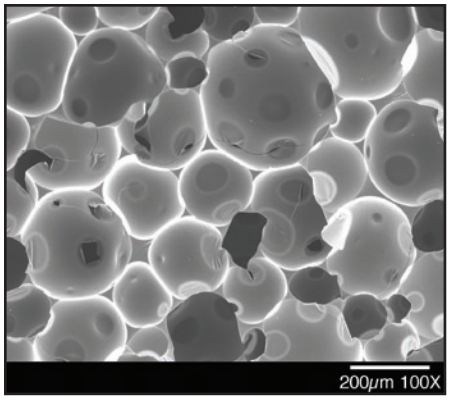
Innovative research in materials and engineering sciences to solve national problems

Combining Science and Engineering

Located at Sandia's California site, the Physical and Engineering Sciences Center offers a broad range of technical expertise, allowing customers the convenience—and efficiency—of "one-stop shopping" for solutions to complex problems.

Our research spans fundamental science to multiphysics modeling and prototype engineering. Applications are as diverse as our expertise: current projects explore hydrogen storage, radiation detection, made-to-order organic materials, fracture mechanics, and high-fidelity modeling of complex weapons systems, among other areas.

Whatever the topic, each project supports Sandia's broad national security mission. Our customers include Department of Energy offices (e.g., National Nuclear Security Administration, Basic Energy Sciences, Energy Efficiency and Renewable Energy), the Department of Defense, and the Department of Homeland Security. We also offer our services to key industrial partners, extending our knowledge to their most challenging engineering problems.



While most of our developments are intended for national security applications, many find wide-ranging commercial value as well—as evidenced by our many R&D 100 awards. A case in point is TufFoam (left). Originally designed to protect sensitive electronics in nuclear weapons, TufFoam has potential applications from surfboards to airplane wings.

Exceptional Staff

We're proud of our world-class talent in materials science, chemistry, engineering (mechanical, nuclear, etc.), physics, computer sciences, and metallurgy. The center comprises approximately 105 permanent staff and about 30 post-doc, temporary, or contract employees—more than 90 PhDs in all—representing diverse ages and ethnicities. We also host visiting faculty and employ many student interns.

Multidisciplinary Teams

The center is organized into interdisciplinary departments. This structure affords a valuable cross-cutting perspective—and the agility to regroup for the needs of special projects—while maintaining the administrative efficiencies of vertical organization. We also partner readily with specialists elsewhere in Sandia, as well as from other national labs, industry, and universities, to assemble the best minds for a given research effort.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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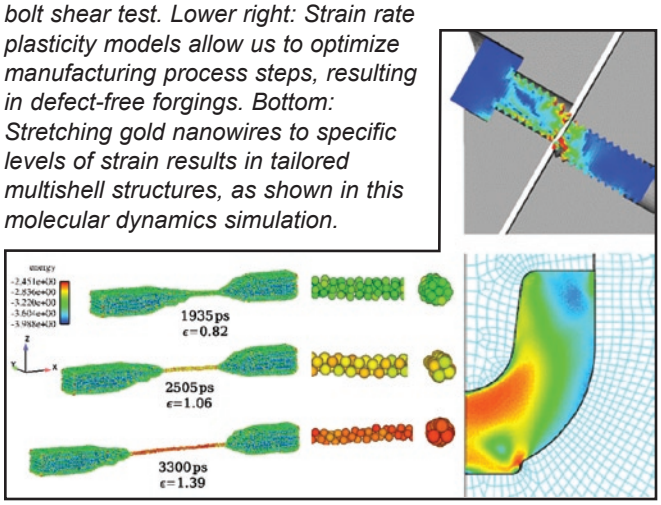
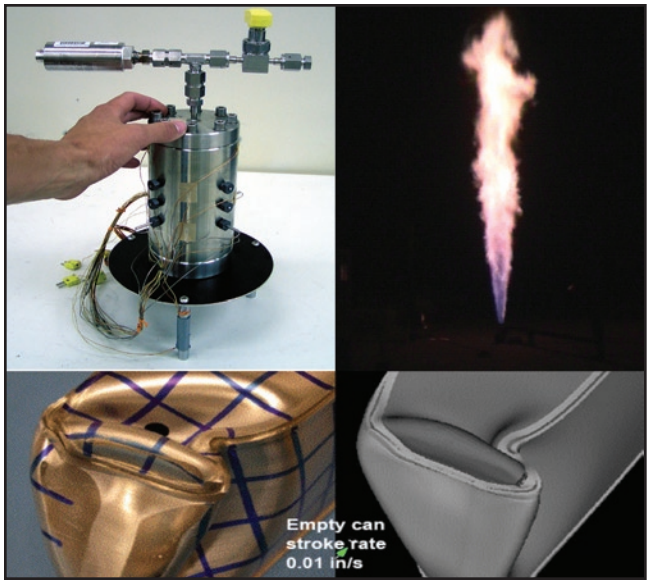
Sophisticated models help us to find a better solution—and to do so faster and cheaper. Upper right: Simulation of a bolt shear test. Lower right: Strain rate plasticity models allow us to optimize manufacturing process steps, resulting in defect-free forgings. Bottom: Stretching gold nanowires to specific levels of strain results in tailored multishell structures, as shown in this molecular dynamics simulation.



Wedding Theory and Experiment

We employ a science-based approach, tightly integrating computer analysis with experiment to quickly arrive at optimal solutions. Our multiphysics models solve complex problems coupling chemical, electrical, thermal, and mechanical behavior to yield highly accurate, detailed results. Simulations range from atomic to macroscale; we emphasize multiscale models that link atomic phenomena with the continuum. As needed, we develop new algorithms and computer codes to facilitate our work.



We validate our models through testing. Top left: Test cell to determine the thermal properties of a candidate metal hydride for storing hydrogen onboard a fuel cell vehicle. Top right: Jet flame from a hydrogen leak to study safety scenarios. Bottom: Crush of a steel can to compare inelasticity calculations with experimental observations.

State-of-the-Art Facilities

Much of our research depends on our ability to see materials in ever-greater detail—at nanoscale dimensions in both space and time. Accordingly, we maintain extensive laboratory facilities to characterize material structure and behavior, including SEM, TEM, HRTEM, 3D TEM, STM, EMPA, LEEM, 3D atom probe, XTM, nuclear spectroscopy, Auger spectroscopy, low-energy ion beam analysis, and phase contrast imaging.

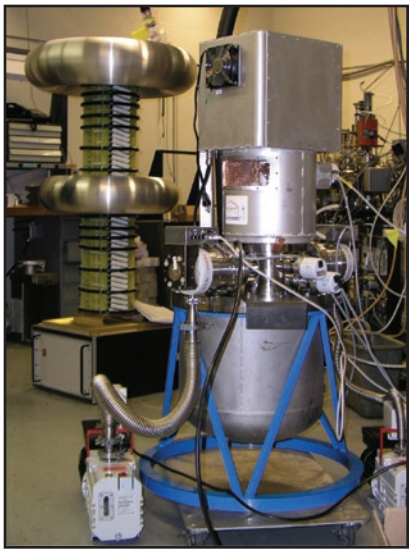
Our high-fidelity multiphysics modeling is made possible by our access to leading supercomputers, including Red Storm, currently the world's fastest. And, of course, we feature specialized test equipment such as our particle accelerators, tritium plasma setup, and hydrogen glovebox.

Future Directions

We are committed to broadening our portfolio of customers while strengthening our core science and engineering capabilities. Future areas of focus include:

- Advanced transportation options (hydrogen vehicles, biofuels)
- Nanoscience, including fluid and ion transport through nanopores
- Surety solutions to protect highly valued assets
- Applying predictive science in the engineering process

This gamma tube prototype emits monoenergetic photons for active interrogation of special nuclear material. Restricting the photons to a single wavelength allows effective detection of heavily enriched uranium in shipping containers—without exceeding dose limits for nearby personnel.



Learn more at: http://public.ca.sandia.gov/8700

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